



## Regular Article

## Factors associated with loneliness in rural Australia: A web-based cross-sectional survey

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## ABSTRACT

**Background:** Loneliness affects approximately 35% of rural Australians with detrimental impacts on physical, emotional, and social health. This study aims to identify the factors associated with loneliness among adults in a rural Australian population.

**Methods:** The study was a web-based cross-sectional survey conducted between February and April 2023 among adults living in a rural Australian population. The survey, which was distributed using social media, consisted of 37 items including demographic information (17 items) and the UCLA Loneliness Scale Version 3 (20 items). Collected data were analysed using univariate and multivariable analysis to identify the factors associated with loneliness in this population.

**Results:** A total of 225 respondents, mostly aged 30–49yrs (42.7%) participated in this study. The majority were Australia-born (88.4%), females (79.6%), employed (70%) and a third of participants were married (34.7%) at the time of this study. The median loneliness score (55 [IQR 47.0–61.0]) was significantly lower among participants who took part in community, sporting or hobby groups (36.2%) compared to those who abstained from these activities (51.5, [IQR 45.3–58.0] vs 56.0 [IQR 48.0–62.0];  $p = 0.037$ ). However, this association was nullified, after adjusting for covariates. Those who rated their overall health as worse (i.e., ‘poor’ 62.5 [IQR 54.8–64.0]) had significantly higher median loneliness scores than those who self-rated their overall health as ‘excellent’ (46.0 [IQR 32.3–54.3];  $p < 0.001$ ). After adjusting for covariates, poorer self-rated overall health remained significantly associated with loneliness, in contrast to ratings of ‘good’, ‘very good’ and ‘excellent’.

**Conclusions:** Results indicate that in this rural Australian population, loneliness is associated with worse self-reported overall health, whilst participation in social groups appear to ameliorate loneliness. Policy aimed at reducing loneliness should therefore facilitate measures that improve this population’s physical and mental health.

## 1. Introduction

Social relationships are the means by which social connection, a key human psychological need and motivator, can be created and maintained (Seppala, Rossomando, & Doty, 2013). Loneliness is characterised by a poverty of such relationships, and hence diminished social connection and emotional fulfillment essential for both human development and survival (Seppala et al., 2013). The ‘cognitive discrepancy model’ defines loneliness as the experience of a discrepancy between desired and actual social relationships (De Jong-Gierveld & Kamphuis,

1985). This subjective experience, as distinct from the objective state of social isolation (Beutel et al., 2017), is currently encountered by ~32% of Australians, with higher rates found in rural areas (35%) (State of the Nation Report, 2023). Concerningly, 15% of the Australian population often or always feels lonely (State of the Nation Report, 2023).

Addressing loneliness is now of key interest due to its detrimental effects on physical, mental, and social health and wellbeing. It has been found that loneliness impairs executive functioning and cognitive performance (Cacioppo & Hawkey, 2009) and has a profound impact on mental health. Specific mental disorders such as depression (Cacioppo,

**Abbreviations:** ANOVA, Analysis of variance; IQR, Interquartile range; NSW, New South Wales; UCLA, University of California, Los Angeles; UCLA-3, University of California, Los Angeles Loneliness Scale Version 3.

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Hughes, Waite, Hawkey, & Thisted, 2006; Ernst & Cacioppo, 1999; Killgore, Cloonan, Taylor, & Dailey, 2020), anxiety (Cacioppo, Hawkey, et al., 2006), and schizophrenia (Ernst & Cacioppo, 1999) are linked with loneliness, and may elicit symptoms of pessimism (Ernst & Cacioppo, 1999), anger (Cacioppo, Hawkey, et al., 2006) and psychological distress (Pressman et al., 2005). These have also been found to contribute to further complications of loneliness, such as alcohol and other substance use (Bonin, McCreary, & Sadava, 2000). Physical health is similarly impacted by loneliness. Disease-specific associations are known to exist with coronary heart disease (Sorkin, Rook, & Lu, 2002; Thurston & Kubzansky, 2009) and late-life dementia (Wilson et al., 2007), potentially driven by loneliness-associated changes via elevated systolic blood pressure (Musich, Wang, Hawkins, & Yeh, 2015) and cortisol (Cacioppo et al., 2000; Pressman et al., 2005), or loss of restorative bodily functions (Cacioppo et al., 2002; Pressman et al., 2005). A study conducted during the pandemic similarly found that loneliness was associated with fewer days of physical healthiness (Howe-Burris et al., 2022), with higher loneliness scores predicting poorer health-related outcomes (Vasan, Lambert, Eikelis, & Lim, 2022). Social health is equally debilitated, as lack of trust, relationship dissatisfaction (Ernst & Cacioppo, 1999), and reduced social support (Cacioppo, Hawkey, et al., 2006) are associated with, and further reinforce loneliness.

Multiple factors are associated with loneliness, influencing the extent to which an individual experiences loneliness. To determine such factors, past studies have indicated the importance of using validated measures for assessing loneliness (Russell, Peplau, & Cutrona, 1980). A literature search revealed that only one study (Gregory, Dutton, Osuagwu, & Vines, 2023) has used a validated questionnaire in assessing loneliness amongst residents in rural Australia, which is the population of interest for this present study. Further, previous Australian studies (Baker, 2012; Flood, 2005; Lauder, Sharkey, & Mummery, 2004; Mellor, Stokes, Firth, Hayashi, & Cummins, 2008; Steed, Boldy, Grenade, & Iredell, 2007) using validated loneliness questionnaires have failed to differentiate between populations geographically, even though significant rural-urban disparity in factors associated with loneliness have been demonstrated in studies conducted in other countries with similar characteristics to Australia (Havens, Hall, Sylvestre, & Jivan, 2004; Marquez et al., 2021). In Canada, 'living alone' was significantly associated with loneliness in rural communities (Havens et al., 2004), while in the United Kingdom geographic disparity has been demonstrated with factors such as gender, ethnic background, and sexual orientation (Marquez et al., 2021). Subsequently, a rural-based Australian study will help to identify the factors unique to rural Australian populations, alleviating this identified weakness of the current literature.

In considering the factors associated with loneliness in Australia, the findings of previous studies using validated loneliness questionnaires are inconclusive, showing variations in their findings. For instance, two studies (Baker, 2012; Flood, 2005) drawing on data from the Household, Income, and Labour Dynamics in Australia surveys found that loneliness was positively associated with being male, living alone (for males only), financial dissatisfaction, and age, with some discordance on the specific age group most affected. Similarly, the association between loneliness and participation in sporting groups or community organisations/clubs also differed between the two studies with a negative association reported in one study (Flood, 2005). Additional Australian studies suggest an association between loneliness and marital status (Lauder et al., 2004; Steed et al., 2007) or employment status (Lauder et al., 2004), family structure (having children under the age of 18 in the house) (Lauder et al., 2004) or perceived overall health (Steed et al., 2007), and reaffirm findings of a significant association with living alone (Steed et al., 2007; Van Beek & Patulny, 2022). However, other studies found no significant association between loneliness and gender (Lauder et al., 2004; Steed et al., 2007), age (Lauder et al., 2004; Steed et al., 2007), or living alone (Mellor et al., 2008). These variations call for further research and perhaps suggest that an association between factors may be

unique to each population being studied.

The reported high prevalence of loneliness in Australia (*State of the Nation Report: Social Connection in Australia 2023.*, 2023), the known detrimental effects of loneliness (Bonin et al., 2000; Cacioppo et al., 2000, 2002; Cacioppo & Hawkey, 2009; Cacioppo, Hawkey, et al., 2006; Cacioppo, Hughes, et al., 2006; Ernst & Cacioppo, 1999; Killgore et al., 2020; Musich et al., 2015; Pressman et al., 2005; Sorkin et al., 2002; Thurston & Kubzansky, 2009; Wilson et al., 2007), and the scarcity of research on factors associated with loneliness in rural communities justify the need for further research in this area for the purpose of informing loneliness-reducing initiatives. The present study was designed, therefore, to understand the level of loneliness experienced by people in rural Australia as well as factors associated with loneliness in this rural Australian population.

## 2. Methods

### 2.1. Ethical considerations

Ethics approval was granted by the Western Sydney University Human Research Ethics Committee in March 2022 (#H14831). The study utilised an implied consent model upon submission of the survey. This process of consent, as well as other ethical information relevant to participants, was presented to all individuals upon opening of the survey through the use of a participant information sheet.

### 2.2. Study design and population

This cross-sectional study was conducted between February 2023 to April 2023 among residents in rural Australia using a web-based survey. The target population was individuals aged 18 years or above residing in the Western NSW Local Health District as defined by the Australian Bureau of Statistics (*Central West*, 2021).

### 2.3. Questionnaire design

The survey consisted of a total of 37 questions (see supplementary file, **STable-1**) and was broken down into demographic items (17 items), and the UCLA Loneliness Scale Version 3 (UCLA-3) questionnaire (Russell, 1996) (20 items). Most questions were closed multiple choice questions, with only two open ended questions; however, a limited range of multiple-choice questions also included an 'other' option which was open ended.

The questions concerning demographic factors were constructed by the research team with reference to previous studies (Baker, 2012; Flood, 2005; Lauder et al., 2004; Mellor et al., 2008; Steed et al., 2007), to capture comparable data. These questions were refined continuously during the study design phase to ensure optimal clarity, suitability of answer options, and relevance to the context of participants. Loneliness evaluation in the survey occurred through inclusion of the UCLA-3 (Russell, 1996). This 20-item questionnaire is self-rated on a four-point Likert-type scale ranging from 1 (never) to 4 (often) and has 10 of 20 items reverse-scored. The range of scores is 20–80, with higher scores indicating higher levels of loneliness (Coleman, 2005). This 20-item questionnaire was chosen because it is the most commonly used self-report measure of loneliness (Steed et al., 2007). This allows us to reliably compare the results of this study with previous studies utilizing the UCLA-3, including those of Australian origin (Mellor et al., 2008; Steed et al., 2007). Additionally, this scale is a highly reliable measure of loneliness, demonstrating satisfactory internal consistency (coefficient alpha 0.89 to 0.94), good test-retest reliability over a 1-year period ( $r = 0.73$ ), and support for convergent and construct validity (Russell, 1996).

The survey underwent final review through self-completion by the research team to evaluate flow, presentation, grammar, and language, before being released. Once the survey was released, only the questions regarding age and location were compulsory to ensure capture of the

target population. Participation was entirely voluntary, and participants were able to exit the survey at any point in time.

### 2.4. Recruitment

Publication of the survey and subsequent data collection was conducted using Qualtrics software (Version 2023; Provo, UT) and distributed through Facebook to the adult population of Central West NSW. Digital flyers displaying information regarding the study, as well as a URL and QR code linking to the survey, were posted across multiple community Facebook pages associated with the geographic location of interest. The re-post rate of the flyers occurred mainly on a fortnightly basis with some variations in re-post frequency based on the guidelines of relevant social media groups and group admin approval. Through a preamble at the start of the survey, participants provided implied consent by ticking a box to indicate whether or not they voluntarily wish to complete the survey.

### 2.5. Inclusion and exclusion criteria

Survey responses from individuals outside the target population were excluded from all statistics. Additionally, responses displaying identical Internet Protocol addresses with similar demographic information, such as age and gender, were considered duplicate entries. In these cases, only the most complete entry was included in the analysis. All remaining participants were included in the descriptive statistics. However, to ensure an accurate evaluation of factor significance, only data from participants who completed the entire UCLA-3 (Russell, 1996) were included in the final analysis.

### 2.6. Statistical analysis

The data was imported from the Qualtrics platform and cleaned in Microsoft Excel. There were 249 raw responses. After removing ineligible responses (n = 18), duplicated responses (n = 6), and responses that did not complete the entirety of the UCLA-3 (n = 26), 199 remained. The data was then analysed in the Jamovi platform (Version 2.3, Sydney NSW).

Normality of the data was assessed using the Shapiro-Wilk test which confirmed that the data set was not normally distributed (W = 0.97, p-value <0.01). Therefore, appropriate non-parametric tests were utilised for all data analyses. The Mann-Whitney U test was used for dichotomous variables, and the non-parametric One-Way ANOVA was used for polychotomous variables. A multiple linear regression model was used to determine the adjusted factors associated with loneliness, incorporating all measured variables. Results were presented as estimates with their 95% confidence intervals (CIs). The level of statistical significance was set at 5%. Since there are no recommended cut-off scores for loneliness using the UCLA-3 scale, loneliness was treated as a continuous variable such that a higher score represents a comparatively higher level of loneliness.

## 3. Results

### 3.1. Sociodemographic characteristics of the sample population

Data for 225 participants were included in this analysis and their sociodemographic characteristics have been presented in Table 1.

Diversity of gender within the sample was limited, with 79.6% identifying as female. Age distribution was broad, with participants falling within the range of 18–87 and the most represented age category being 30–49 (42.7%). An overwhelming 95.1% of the respondents were Australian citizens and a significant proportion of participants (88.4%) were Australian born. On relationship status, 34.7% were married and 30.7% were single. There was an even spread in the living arrangements with 27.6% of participants residing alone, 24% residing with a

**Table 1**  
Sociodemographic characteristics of the sample population.

Demographics	Frequency (%)
<b>Age Categories (n=225)</b>	
18–29	33 (14.7)
30–49	93 (41.3)
50–64	75 (33.3)
65–87	24 (10.7)
<b>Gender (n=225)</b>	
Female	179 (79.6)
Male	42 (18.7)
Non-binary	4 (1.8)
<b>Residency Status (n=225)</b>	
I am an Australian Citizen.	214 (95.1)
I am a permanent or temporary resident.	9 (4.0)
I am a permanent resident.	2 (0.9)
<b>Australian Born (n=225)</b>	
Yes	199 (88.4)
No	26 (11.6)
<b>Culturally or Linguistically Diverse (n=224)</b>	
No	199 (88.8)
Yes	25 (11.2)
<b>Participation in Community, Sporting or Hobby Groups (n=221)</b>	
No	141 (63.8)
Yes	80 (36.2)
<b>Audio Call (n=220)</b>	
Daily	105 (47.7)
Weekly	74 (33.6)
Monthly	30 (13.6)
Never	11 (5.0)
<b>Video Call (n=221)</b>	
Daily	26 (11.8)
Weekly	71 (32.1)
Monthly	65 (29.4)
Never	59 (26.7)
<b>Social Media (n=221)</b>	
0–1 h	61 (27.6)
1–2 h	73 (33.0)
More than 2 h.	87 (39.4)
<b>Technology Use During Lockdown (n=221)</b>	
Almost never.	7 (3.2)
Less than once per week.	18 (8.2)
At least once per week.	26 (11.8)
2 to 3 times per week.	44 (19.9)
Almost every day.	126 (57.0)
<b>Overall Health (n=221)</b>	
Excellent	9 (4.1)
Very Good	31 (14.0)
Good	83 (37.6)
Fair	70 (31.7)
Poor	28 (12.7)
<b>Employed (n=220)</b>	
Yes	154 (70.0)
No	66 (30.0)
<b>Relationship Status (n=225)</b>	
Married	78 (34.7)
In a relationship	42 (18.7)
Single	69 (30.7)
Divorced (not remarried)	21 (9.3)
Widowed	11 (4.9)
Other:	4 (1.8)
<b>Living arrangements (n=225)</b>	
I reside with my long-term partner or spouse and children.	56 (24.9)
I reside with my long-term partner or spouse only.	54 (24.0)
I reside with my children only.	23 (10.2)
I reside with a roommate/flat mate(s).	14 (6.2)
I reside alone.	62 (27.6)
Other:	16 (7.1)

significant other, and 24.9% residing with a significant other plus child. Employment status varied, with 70% of respondents identifying as employed, as was community involvement, where 36.2% reported actively participating in community, sporting, or hobby groups in the last 12 months. Many individuals (69.3%) rated their own health as good (37.6%) or fair (31.7%), with only a few considering their health as excellent (4.1%). In addition, the use of different technologies varied

among participants, with 47.7% engaging in daily audio calls and only 11.8% utilizing daily video calls. A substantial 72.4% of the sample reported more than 1-h daily usage of social media.

### 3.2. Median score for loneliness among resident in rural Australia

A total of 199 participants completed the entirety of the UCLA-3. The median loneliness score among these participants was 55 [IQR 47.0–61.0]. Since there are no recommended cut-off score for loneliness using the UCLA-3 scale, loneliness was treated as a continuous variable such that a higher score represents a comparatively higher level of loneliness.

### 3.3. Unadjusted factors associated with loneliness in rural Australia

The results of Mann-Whitney U Independent Samples T-test and Non-parametric One-Way ANOVA are presented in Table 2.

For those who participated in community, sporting or hobby groups in the last 12 months, their median score for loneliness was significantly lower than those who did not participate in such groups [51.5, IQR 45.3–58.0 versus 56.0, IQR 48.0–62.0;  $p = 0.037$ ] see Fig. 1.

Participants who self-reported their overall health as worse, had significantly higher median loneliness score than their counterparts ( $p < 0.001$ ). The median loneliness scores shown in Fig. 2 showed that median loneliness scores increased significantly with worse self-reported health (excellent [46.0, IQR 32.3–54.3], very good [48.0, IQR 40.0–56.0], good [53.0, IQR 45.8–58.0], fair [58.0, IQR 52.0–63.5], poor [62.5, IQR 54.8–64.0]). All other factors were not significantly associated with loneliness scores.

### 3.4. Adjusted factors associated with loneliness in rural Australia

After adjusting for covariates, self-rated health was the only significant factor associated with loneliness in this population (Table 3). Individuals who rated their health as ‘good’ (Estimate =  $-4.43$ , 95%CI  $-8.07, -0.79$ ,  $p = 0.017$ ), ‘very good’ (Estimate =  $-8.66$ , 95%CI  $-13.68, -3.65$ ,  $p < 0.001$ ) and ‘excellent’ (Estimate =  $-12.33$ , 95%CI  $-20.62, -4.04$ ,  $p = 0.004$ ) had significantly lower loneliness scores compared to those who rated their overall health as being worse. Participation in community, sporting or hobby groups in the last 12 months was no longer significantly associated with loneliness scores after adjusting for covariates (Estimate =  $-1.78$ , 95%CI  $-3.81, 3.04$ ,  $p = 0.826$ ).

## 4. Discussion

Given the high incidence of loneliness in Australia (First insights, 2021; State of the Nation Report: Social Connection in Australia 2023., 2023), the considerable burden of disease associated with loneliness (Bonin et al., 2000; Cacioppo et al., 2000, 2002; Cacioppo & Hawkey, 2009; Cacioppo, Hawkey, et al., 2006; Cacioppo, Hughes, et al., 2006; Ernst & Cacioppo, 1999; Killgore et al., 2020; Musich et al., 2015; Pressman et al., 2005; Sorkin et al., 2002; Thurston & Kubzansky, 2009; Wilson et al., 2007), and the current lack of research in rural areas, we sought to examine the factors associated with loneliness among adults in a rural Australian population. Using a validated loneliness questionnaire, we were able to effectively explore the association between demographic factors and loneliness levels within this population. The study found a negative unadjusted association between loneliness and participation in community, sporting, or hobby groups, with a strong positive adjusted association being found between loneliness and worse self-reported overall health. All other sociodemographic factors of age, gender, birth country, residency status, relationship status, employment, living arrangements, cultural or linguistic diversity, and technology use were not significantly associated with loneliness in this population. Loneliness scores in our sample were notably higher than those previously recorded in Australia. Using the UCLA-3 scale, Steed et al. (Steed

**Table 2**  
Loneliness according to sociodemographic characteristics.

Variable	Loneliness		
	Median (IQR)	P-Value	N (%)
<b>Age Categories<sup>a</sup></b>			
18–29	55.5 (45.8–62.0)	0.329	24 (12.1)
30–49	56.0 (46.0–63.0)		85 (42.7)
50–64	56.0 (50.0–59.0)		71 (35.7)
65–87	52.0 (39.0–55.5)		19 (9.6)
<b>Gender<sup>a</sup></b>			
Female	55.0 (46.0–61.0)	0.691	156 (78.4)
Male	56.0 (47.0–62.0)		39 (19.6)
Non-binary	53.0 (52.0–57.0)		4 (2.0)
<b>Residency Status<sup>b</sup></b>			
I am a permanent or temporary resident.	52.0 (50.0–55.0)	0.594	9 (4.5)
I am an Australian Citizen.	55.0 (47.0–61.8)		190 (95.5)
<b>Australian Born<sup>b</sup></b>			
No	57.5 (51.5–61.5)	0.221	24 (12.1)
Yes	53.2 (46.0–61.0)		175 (87.9)
<b>Culturally or Linguistically Diverse<sup>b</sup></b>			
No	54.5 (47.0–61.0)	0.943	178 (89.9)
Yes	56.0 (48.8–61.5)		20 (10.1)
<b>Participation in Community, Sporting or Hobby Groups<sup>b</sup></b>			
No	56.0 (48.0–62.0)	0.037	125 (62.8)
Yes	51.5 (45.3–58.0)		74 (37.2)
<b>Audio Call<sup>a</sup></b>			
Daily	52.0 (45.0–58.5)	0.135	95 (47.7)
Weekly	57.0 (50.0–62.0)		70 (35.2)
Monthly	56.5 (52.3–62.0)		26 (13.1)
Never	55 (51.8–60.8)		8 (4.0)
<b>Video Call<sup>a</sup></b>			
Daily	52.5 (46.8–59.5)	0.100	24 (12.1)
Weekly	53 (45.0–62.0)		67 (33.7)
Monthly	53 (45.3–59.5)		58 (29.2)
Never	58 (53.0–61.0)	50 (25.1)	
<b>Social Media<sup>a</sup></b>			
0–1 h	54.0 (47.0–60.8)	0.377	54 (27.1)
1–2 h	53.5 (47.3–58.8)		66 (33.2)
More than 2 h.	57.0 (56.5–63.5)		79 (39.7)
<b>Technology Use During Lockdown<sup>a</sup></b>			
Almost every day.	54.5 (46.0–61.0)	0.491	118 (59.3)
2 to 3 times per week.	56.0 (50.0–63.0)		37 (18.6)
At least once per week.	54.0 (47.0–59.0)		21 (10.6)
Less than once per week.	55.0 (51.0–64.0)		17 (8.5)
Almost never.	62.5 (53.5–67.0)	6 (3.0)	
<b>Overall Health<sup>a</sup></b>			

(continued on next page)

Table 2 (continued)

Variable	Loneliness		
	Median (IQR)	P-Value	N (%)
Excellent	46.0 (32.3–54.3)	<0.001	8 (4.0)
Very Good	48.0 (40.0–56.0)		29 (14.6)
Good	53.0 (45.8–58.0)		72 (36.2)
Fair	58.0 (52.0–63.5)		68 (34.2)
Poor	62.5 (54.8–64.0)		22 (11.1)
<b>Employed<sup>b</sup></b>			
No	56.0 (50.0–64.0)	0.251	57 (28.8)
Yes	54.0 (47.0–60.0)		141 (71.2)
<b>Relationship<sup>a</sup></b>			
Married	55.0 (44.0–61.0)	0.945	69 (34.7)
In a relationship	56.0 (47.8–61.3)		36 (18.1)
Single	55.0 (49.0–61.0)		61 (30.7)
Widowed	54.0 (45.0–59.0)		9 (4.5)
Divorced (not remarried)	54.0 (50.8–58.8)		20 (10.1)
Other:	57.0 (49.3–65.0)		4 (2.0)
<b>Living Arrangements<sup>a</sup></b>			
I reside alone.	54.0 (48.8–60.3)	0.860	56 (28.1)
I reside with a roommate/flat mate(s).	50.0 (46.0–58.0)		12 (6.0)
I reside with my children only.	58.0 (52.5–61.0)		19 (9.6)
I reside with my long-term partner or spouse and children.	56.0 (45.0–62.0)		49 (24.6)
I reside with my long-term partner or spouse only.	55.0 (44.0–61.0)		49 (24.6)
Other:	51.5 (47.3–61.8)		14 (7.0)

<sup>a</sup> Non-parametric One-Way ANOVA test used.

<sup>b</sup> Mann-Whitney U Independent Samples T-test used.

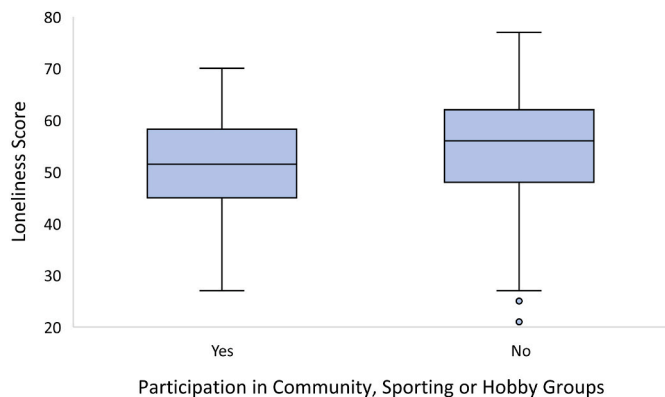


Fig. 1. Loneliness scores distributed by participation in community, sporting or hobby groups in the last 12 months.

et al., 2007) reported a mean loneliness score of 35.61, while our study observed a median score of 55. This difference is likely attributable to variations in the study populations, including the use of metropolitan participants and an age criterion of 65 years and older. Although age was not a significant factor in our findings, the influence of metropolitan

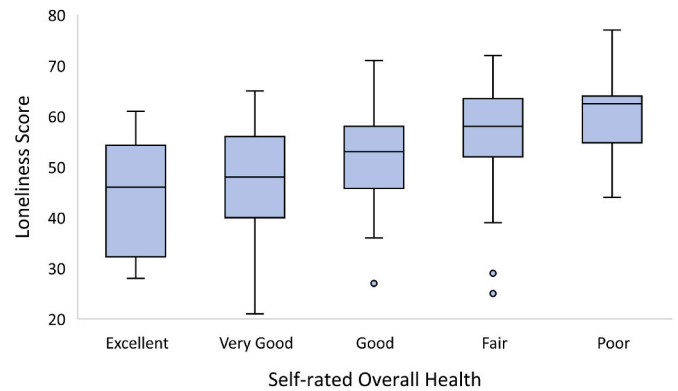


Fig. 2. Loneliness scores distributed by self-reported overall health.

versus rural location on loneliness deserves further investigation.

As outlined, this study found a significant negative unadjusted association between loneliness and involvement in community, sporting or hobby groups in the last 12 months. Similar significance has been observed in previous Australian studies, with some research describing participation in clubs and sporting groups as acting as a buffer against loneliness (Flood, 2005), or in a broader context, community disconnection being associated with greater loneliness (Baker, 2012). This observation may be accounted for by the rise in social support experienced in these forms of community involvement (Flood, 2005), in which active membership of sporting or community organisations produces a higher level of perceived support and friendship (Baker, 2012). Given this study also contradicts other studies in which no association was found between the two (Baker, 2012), we suggest this may be due to differing criteria being used for involvement in social groups. Through using more stringent and limited criteria, such as the need for ‘full membership’ (Baker, 2012), previous research may be neglecting other forms of valued social group participation, which we have instead captured with less strict inclusion criteria. A difference in measurement techniques of social inclusion and loneliness levels may therefore have produced these discrepancies between studies. Finally, the loss of significant association between loneliness and this variable of participation in community, sporting or hobby groups in the multiple linear regression model should be considered in the context of the sample size. The reduced statistical power resultant from our small sample size increases the chance of type II errors (Knudson & Lindsey, 2014), i.e. false-negatives, which may be the case for this variable of social group participation.

As outlined previously, the study also found a significant association between loneliness and self-reported overall health, with reduced loneliness being seen in those with better perceived health. This association did retain significance in the multiple linear regression model. Such a finding was not elicited by Gregory et al. (Gregory et al., 2023) in the only similar study focussing on this population. Importantly, the study by Gregory et al. (Gregory et al., 2023) was limited to individuals aged 16 to 24, an age category at reduced susceptibility to poor health as compared to older adults with increased prevalence of disease-specific risk factors (Prince et al., 2015). In contrast to Gregory et al. (Gregory et al., 2023), Steed et al. (Steed et al., 2007) who, like this study, utilised the UCLA-3 (Russell, 1996) in an older Australian population, demonstrated a significant association between loneliness and negatively perceived health. This finding concurs with international data (Burholt & Scharf, 2014; Savikko, Routasalo, Tilvis, Strandberg, & Pitkälä, 2005; Victor, Scambler, Bowling, & Bond, 2005) in which overall health plays a complex role in influencing loneliness, potentially by reducing social participation and social resources (Burholt & Scharf, 2014). Physical health can impair an individual’s ability to sustain routine lifestyles and hence result in isolation and loneliness (Slivinske, Fitch, & Morawski, 1996), potentially through the mechanisms of physical lack of access to

**Table 3**  
Multiple linear regression of factors associated with loneliness and their 95% confidence intervals (CI).

Predictor	Estimate	95% CI	P-value
Intercept <sup>a</sup>	42.86	33.08–52.64	<0.001
<b>Age Categories:</b>			
65-87 – 50-64	-4.91	-11.75–1.93	0.158
30-49 – 50-64	0.89	-2.87–4.64	0.642
18-29 – 50-64	-0.55	-6.48–5.39	0.856
<b>Gender:</b>			
Non-binary – Female	3.38	-8.78–15.54	0.584
Male – Female	2.19	-1.88–6.25	0.290
<b>Residency Status:</b>			
I am a permanent or temporary resident. – I am an Australian Citizen.	-4.62	-12.87–3.63	0.270
<b>Australian Born:</b>			
No – Yes	4.96	-0.82–10.73	0.092
<b>Culturally or Linguistically Diverse:</b>			
Yes – No	-1.78	-7.46–3.90	0.537
<b>Participation in Community, Sporting or Hobby Groups:</b>			
Yes – No	-0.38	-3.81–3.04	0.826
<b>Audio Call:</b>			
Monthly – Daily	0.59	-5.08–6.25	0.838
Weekly – Daily	-0.14	-3.84–3.56	0.940
Never – Daily	1.62	-7.14–10.38	0.715
<b>Video Call:</b>			
Weekly – Monthly	1.36	-2.60–5.32	0.498
Never – Monthly	4.30	-0.14–8.74	0.058
Daily – Monthly	1.511	-4.04–7.06	0.591
<b>Social Media:</b>			
0–1 h – 1–2 h	-1.45	-5.56–2.66	0.488
More than 2 h – 1–2 h	0.54	-3.28–4.35	0.782
<b>Technology Use During Lockdown:</b>			
Almost every day. – Less than once per week.	-1.33	-7.44–4.77	0.667
2 to 3 times per week. – Less than once per week.	-1.82	-8.45–4.81	0.588
Almost never. – Less than once per week.	5.73	-5.03–16.48	0.295
At least once per week. – Less than once per week.	-1.16	-8.12–5.79	0.742
<b>Overall Health:</b>			
Excellent – Fair	-12.33	-20.62–4.04	0.004
Good – Fair	-4.43	-8.07–0.79	0.017
Poor – Fair	2.09	-3.48–7.67	0.460
Very Good – Fair	-8.66	-13.68–3.65	<0.001
<b>Employed:</b>			
No – Yes	0.36	-3.48–4.2	0.853
<b>Relationship Status:</b>			
Married – Single	2.34	-6.41–11.08	0.599
In a relationship – Single	2.97	-4.81–10.74	0.452
Other: Single	3.14	-8.17–14.44	0.585
Divorced (not remarried) – Single	-1.27	-7.30–4.76	0.677
Widowed – Single	3.48	-5.56–12.52	0.448
<b>Living Arrangements:</b>			
I reside with my long-term partner or spouse and children. – I reside alone.	-1.84	-10.61–6.94	0.680
I reside with my long-term partner or spouse only. – I reside alone.	-3.20	-11.78–5.38	0.463
I reside with a roommate/flat mate(s). – I reside alone.	0.77	-6.22–7.75	0.829
Other: I reside alone.	-2.21	-9.42–4.99	0.545
I reside with my children only. – I reside alone.	3.84	-2.23–9.91	0.213

Confidence intervals (CI).

<sup>a</sup> Represents reference level.

social activities or relationships, avoidance of social engagement because of concern about becoming a burden, or fear of judgment, or even maladaptive coping strategies such as social withdrawal. Similarly, another component of overall health, mental health, has been shown to influence loneliness in, for example, a reciprocal relationship between depressive symptoms and loneliness (Cacioppo, Hughes, et al., 2006).

Many factors tested within this study did not display a significant association with loneliness, both concurring with and contradicting previous research. Social media use, in particular duration of use, was an

essential variable to measure given the important role it may play in improving social capital and connectivity in rural Australia (Tiwari, Lane, & Alam, 2019). However, time spent on social media displayed the same lack of association that Gregory et al. described in a younger cohort of the same population (Gregory et al., 2023). Like Gregory et al. (Gregory et al., 2023), this may be due to the majority of survey participants using social media less frequently than the 3-h threshold set by previous research for negative mental health effects (Riehm et al., 2019), or it may indicate that concerns surrounding the negative impacts of social media on loneliness are misplaced (Berryman, Ferguson, & Negy, 2018). Age and gender are two demographic factors that have also previously demonstrated a lack of association with loneliness within Australia (Lauder et al., 2004; Steed et al., 2007). This suggests that across the age spectrum there are varying protective and harmful influences on loneliness that prevent age disparities. For instance, the active lifestyle and technology use of younger generations may be equally efficient at minimising loneliness as the intergenerational relationships and life satisfaction gained by older generations.

The lack of gender significance is consistent with previous studies using the UCLA-3. Through the use of indirect loneliness measurement, the UCLA-3 overcomes previously described artificial gender disparities in loneliness by minimising potential male reluctance to indicate direct feelings of loneliness (Borys & Perlman, 1985). Living arrangements as a factor associated with loneliness also exhibits variability in the Australian literature. Steed et al. (Steed et al., 2007) documented a significant relationship between loneliness and living alone across all measures of loneliness. In contrast, Lauder et al. (Lauder et al., 2004) and Mellor et al. (Mellor et al., 2008) found no association between living alone and loneliness, concluding that cohabiting individuals may have similar deficiencies in wanted social connection as those living alone. In contrast to some studies (Lauder et al., 2004; Steed et al., 2007), marital status did not show a significant association with loneliness in our study, which could be related to different variable structure for 'relationship status' used between studies. The previous study (Lauder et al., 2004) separated 'married' from 'cohabiting relationships', as opposed to collapsing this variable as one category in our study which may mask the influence of each clearly distinct relationship status.

#### 4.1. Limitations and strengths

While the study design, a self-reported cross-sectional survey, is valuable in determining associations and prevalence, it has inherent limitations. Cross-sectional surveys are primarily observational, and thus are unable to determine causality (Levin, 2006). Further, they exhibit temporal ambiguity whereby variable development or progression is unable to be commented upon (Levin, 2006). Additional limitations arise with self-report data, primarily the possibility of recall bias which may potentially under-represent or exaggerate the associations reported in this study (Raphael, 1987). Due to time constraints placed on the study, these limitations could not be overcome by employing a longitudinal study design. Having a low sample size for statistical analysis, n = 199, was also a limitation through a potential reduction in statistical power (Knudson & Lindsey, 2014). Despite these limitations, however, the study still makes a valuable contribution by selectively collecting and analysing data on such a topical issue in a specific rural Australian population. Further, the study has acquired the largest data set to date, using a validated loneliness questionnaire in this population. Another potential constraint might be participant unwillingness to partake in research of such emotional sensitivity (Gregory et al., 2023), particularly for males (Borys & Perlman, 1985). This potential contributor of selection bias may have been a driver in the disparity between captured and actual gender distribution of the region, with 18.7% of survey participants identifying as male, compared with 49.9% of recent census respondents identifying as male (Central West, 2021). However, this disparity is less pertinent for age, with the median age of the sample being 47, comparable to the Central West area's median age of (47

versus 41 years) (Central West, 2021) and to a larger extent, these study findings may be representative of the study population. Collection of data online through social media has also introduced the potential for selection bias (Fricker, 2017). However, a web-based survey was necessary to counter geographic restrictions that prevented localized physical recruitment. Finally, limitations arise when attempting to investigate a broad variety of variables within a short-form survey, namely the inability to capture extensive information for all variables. For example, community participation was assessed through a simple 'yes' or 'no' response regarding participation in community, sporting, or hobby groups in the last 12 months. This factor lost statistical significance in multivariate analysis. Given that community participation is a known influencer of mental well-being in rural Australia (Dashputre et al., 2023), it may have retained significance in the linear regression model if more specific information had been recorded, such as participation frequency, to form a more informative polychotomous variable.

Despite these described limitations, the study still makes a valuable contribution to the loneliness literature. A validated tool to measure the level of loneliness specifically within this rural population has only been used once before (Gregory et al., 2023), was restricted to the age category of 16–24 and focused on social media use. By including the entire adult population of the region and broadening the scope of variables assessed, the study contributes new data which may assist in developing future targeted interventions to increase social connection. Further, the robust analysis enabled the assessment of factors associated with loneliness.

#### 4.2. Recommendations

To aid loneliness reduction, future loneliness research amongst rural Australians would be optimised through using longitudinal study designs, web-based and in-person recruitment, larger sample sizes, and inclusion of adolescents who are an at risk population for loneliness (Lasgaard, Friis, & Shevlin, 2016). The research findings presented here should be consulted in the development of loneliness-reducing policy, in particular, the importance of improving overall health in mitigating loneliness. Involvement in community, sporting, or hobby groups appear to have some impact on loneliness.

#### 5. Conclusion

The study undertaken supports current literature that suggests certain demographic factors are associated with loneliness, in a harmful or protective manner. Of significance, was the association observed between self-reported overall health and loneliness, with loneliness significantly increasing with negatively perceived health. Also of importance, was the protection against loneliness provided by participation in community, sporting, or hobby groups; however, this lost significance in adjusted analysis, potentially because of the small sample size. Loneliness-reducing interventions tailored to this specific population would potentially be assisted by targeting these issues with mental, physical, and social health initiatives, as well as providing increased social group opportunities within the local community.

#### Consent for publication

Not applicable.

#### Ethics approval and consent to participate

Ethics approval was granted by the Western Sydney University Human Research Ethics Committee in March 2022 (#H14831) prior to survey distribution. The study utilised an implied consent model upon submission of the survey. A participant information sheet, which outlined this process of consent, was provided to all participants upon opening of the survey. Also provided in this document was a project

summary, participant requirements, outlining of future use and storage of data, as well as contact information of the research team. Finally, the participant information sheet also declared the potential for participant discomfort due to the survey's contents and provided the contact details for Beyond Blue and Lifeline in the event of requiring access to support.

#### Availability of data and materials

The dataset supporting the conclusions of this article is included within the article (and its additional files). Data is also **available on request from the corresponding author**.

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#### CRedit authorship contribution statement

**Jackson Barton:** Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Uchechukwu Levi Osuagwu:** Writing – review & editing, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Krista Cockrell-Reed:** Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization. **Robyn Vines:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Conceptualization.

#### Declaration of competing interest

The authors declare that they have no conflict of interest.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssaho.2024.101154>.

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